UNITED NATIONS
ECONOMIC
AND
SOCIAL COUNCIL

GENERAL

E/ESCAP/STC.8/5
8 November 1984

ORIGINAL: ENGLISH

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

Committee on Shipping, and Transport and Communications
(Shipping, Ports and Inland Waterways Wing)

Eighth session
8-14 January 1985
Bangkok

MAJOR ISSUES IN THE FIELD OF SHIPPING, PORTS AND INLAND WATERWAYS:

DREDGING FOR DEVELOPMENT

(Item 5 (c) of the provisional agenda)

Note by the secretariat

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1. The introduction of larger oil tankers and bulk carriers, more intensive shipping activity, changes in the methods of handling cargo and the creation of industries adjacent to deepwater ports have led to increased demands for deep entrance channels, deeper harbour basins and extensive reclamation. These demands, relating to both capital and maintenance, have generated special requirements across the entire spectrum of dredging processes. More specifically, some of these are:

(a) To dredge larger quantities per unit and per time-unit;
(b) To dredge deeper;
(c) To transport spoil over long distances;
(d) To work in exposed waters;
(e) To dredge harder soils;
(f) To have closer monitoring of the dredging process.

2. Technological advances to meet these problems, based on a better understanding of dredging processes, relate mainly to the provision of increased power through the application of medium-speed diesel engines, submerged dredge pumps, centralized controls on the bridge, and extensive use of instrumentation supplemented with logic circuits and processing equipment (electronic computers and microprocessors) providing means for semi-automating the dredging process. Various features designed to improve performance have been or are being incorporated in modern dredgers, chiefly in hydraulic dredgers.

3. Hopper dredgers have been provided with direct-pumping self-unloading hoppers, doppler ground speed indicators for accurate ship speed measurement, dragarm-mounted submerged pumps for increased dredging depths, improved dragheads (active draghead) and variable overflow and anti-turbidity overflow systems. A split-hull type of construction and an increase in the number and size of sliding horizontal hopper doors help in faster and cleaner dumping. There is enough instrumentation to automate the dredging process either in part or fully, and constant tonnage loading systems are increasingly in use.

4. Cutter suction dredgers use an advanced design of cutter appropriate to the soil. In some cases, a dredging wheel or a bucket wheel has replaced conventional cutters. Improved anchoring systems, spud carriage systems, ladder-mounted submerged dredge pumps, swell compensating devices on ladders and self-floating pipelines are also becoming more popular. Improved devices, such as dredging-pressure instrumentation and automatic cutter-control equipment, are helping considerably to improve productivity.

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5. Mechanical dredgers are being fitted with improved digging capability. Automation is being applied to certain elements of them, as is improved instrumentation meant to display the digging angle of the dipper and backhoes.

6. The picture in the developing Asian and Pacific region closely follows the world pattern. There is an increased demand for dredging to provide navigational facilities in ports similar to those in the developed world, their partners in trade. The tools to meet the increased demand are becoming highly sophisticated, capital-intensive and semi- or fully automated. Thus it has become necessary to improve dredging equipment and methods, to provide efficient management and to give adequate exposure to advanced technology. Expertise needs to be developed in the following:

(a) The establishment of project boundary conditions in the economic and technical sense;

(b) Designing dredging projects;

(c) Understanding dredging processes and methods;

(d) The conception and design of dredging equipment;

(e) The maintenance of dredging equipment;

(f) The management of dredging projects;

(g) The execution of dredging projects.

7. A survey was conducted by the ESCAP secretariat during 1984 of dredging in the developing countries and areas in the Asian and Pacific region. The findings of the survey are to be found in the annex to this document. Capital dredging requirements are extensive. Periodic maintenance dredging, which is essential for operations at seaports, has become more demanding as delays in undertaking this often mean lost resources, increased shipping costs and lessened port efficiency. These effect the very vitality of the port, its hinterland and the country. At the same time, manpower development and technology upgrading has lagged behind. This has given rise to a number of problems which may for convenience be grouped into three major sets.

(a) Planning and management related problems:

(i) Insufficient knowledge about project identification and establishing the inescapability of dredging;

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(ii) Insufficient preparation for projects - inadequacies in investigations and surveys, incorrect assessment of dredging requirements (capital and maintenance) and insufficient attention to coastal engineering phenomena and the hydraulics of sediment transport;

(iii) Unsatisfactory project designs;

(iv) Badly designed contract documents;

(v) Inept project management and contract management;

(vi) Insufficient financial allocations;

(b) Equipment related problems:

(i) A large proportion of the equipment held and used in a number of countries is very old and largely inefficient. Such equipment is prone to break down more often and owing to non-availability of spare parts remains out of order for longer intervals;

(ii) Dredgers are usually small, uneconomic and unable to meet the enhanced demands for dredging;

(iii) Some new plants that have been purchased are unsuitable for specific tasks and/or working conditions;

(iv) There is a lack of support craft and equipment - barges, tugs, pipelines etc. - thereby reducing the productivity of the dredging units;

(v) Many dredgers are not equipped with instruments (or the instruments are not working) which assist in measuring performance and act as aids to improving productivity;

(vi) Concepts of regular preventive maintenance are not adequately developed and the plants are often in a poor state of repair;

(vii) Repair facilities are sometimes inadequate and the institutional arrangements required to obtain spare parts are ineffective.

(c) Problems relating to the operation of dredgers:

(i) Low productivity because of a lack of technical skills and knowledge on the part of masters and crews;

(ii) Operations insufficiently prepared and poorly planned;

/(iii)

(iii) Concepts of effective productivity very confused so that there is no real check or analysis of performance;

(iv) Alternative dredging processes not fully understood and dredging sometimes carried out using inefficient or uneconomic methods;

(v) Very often a survey report which is essential for the continuous measuring of the results of dredging and for directing operations is not available.

8. The strategy to meet these problems was evolved at the Expert Group Meeting on Dredging held at Bangkok in August 1976. The Meeting suggested that ESCAP should have the following capabilities:[1/]

(a) The immediate mobilization of existing resources;

(b) The development of training programmes related to manpower development;

(c) Making available advice of both a technical and a management nature to those countries in the region expressing a desire for advisory services;

(d) Establishing a data bank and the development of facilities for the dissemination of information;

(e) Harmonizing a number of aspects related to dredging;

(f) Standardization;

(g) Developing institutional and other aspects related to dredging.

9. Within the very limited resources available in the last two years ESCAP programmes have been evolved to conform to this suggested strategy and to meet the situation as revealed by the survey. The following programmes have been implemented:

(a) The Seminar on the Management of the Dredging Industry for policy makers and planners in the Asian and Pacific region was organized at Shanghai, China, in December 1983. It was attended by 14 participants from nine countries and 20 observers from China. It covered four main topics: the state of the art, planning process, financial evaluation and cost effectiveness, and management methods and systems. The proceedings of the Seminar have been sent to all participants and interested governments;

/(b)

1/ See Report of the Expert Group Meeting on Dredging (E/ESCAP/TRADE.20/20 and E/ESCAP/TRANS.25/29 of 22 September 1976), paras. 27-33.

(b) The Seminar on the Dredging Project was conducted at Bangkok in October 1984 for designers and managers. It was attended by 18 participants from 12 countries. It covered four main topics: site investigation and surveys, design of a project, pre-post Execution activities, and site management;

(c) A country-level seminar for 30 participants was organized at Wuhan, China, at the request of the Government;

(d) A research project on developing low-cost dredging technology for application to small waterways and ports is under execution. Conventional dredging is too expensive for these small ports and waterways and is very complex in terms of technology and operational skills. Low-cost dredging techniques using the natural properties of water which is constantly in motion, developed with the help of the Danish Hydraulic Institute and financial assistance from the Danish International Development Agency, are currently undergoing field trials. The results of these will be available to member Governments during 1985;

(e) Advisory services have been rendered to the following countries: China, Indonesia, Lao People's Democratic Republic, Malaysia, Maldives and Thailand. The advice covered organizational, management, operational and training problems connected with sedimentology, hydrographic surveys and dredging;

(f) A training programme was organized for the Government of Maldives in two parts:

(i) Three crew members from Maldives were trained on an operational dredger of the Dredging Corporation of India through the kindness and courtesy of the Government of India;

(ii) Two expatriate experts in operational and mechanical disciplines were located at Male for a period of seven months to impart on-the-job training to the operational and mechanical crews of government dredgers.

10. The strategy for the next three years continues to be based on the recommendations of the Expert Group Meeting on Dredging and the directions given by the Committee and the Commission. Planning and management problems will be treated through regional and country-level seminars. Resources permitting there will be one regional seminar and two country-level seminars every year. The subjects that it is proposed to cover at the regional seminars are equipment, processes and instrumentations in 1985, dredging contracts in 1986 and hydrographic surveying and dredging in 1987.

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11. The publication on low-cost dredging techniques will become available in 1985. Advisory services to Governments needing assistance in identifying ports and waterways where such techniques might be profitably applied and technical guidance on their installations will be available.

12. During these three years the training programme successfully tried out in Maldives will be extended to three or four other countries. Experts will be available to assist in on-the-job training in operational or mechanical disciplines.

13. Ad hoc advisory services for specific organizational, management or operational problems will continue to be extended to countries on request.

14. A problem which needs the special attention of the Committee concerns the assessment of training facilities and institutions for the training of technicians for the dredging industry. As can be seen from the survey there are hardly any formal training facilities available within the region, the notable exceptions being those for training of tradesmen and junior executives in China and India. It is also evident that the requirement of each country, except perhaps China and India, is not big enough to warrant setting up a national facility/institution for that purpose. The solution therefore seems to lie in setting up regional or subregional facilities for this purpose. A study of the regional situation, to examine requirements, and to survey existing facilities so as to determine how to build on them, has been projected for 1986-1987.

15. The Committee may wish to consider the plans for 1985 and the 1986-1987 biennium and suggest modifications. It may like to call on the donor countries and the United Nations Development Programme to make available funds for the implementation of this minimum programme of action.

/Annex

Annex

FINDINGS OF THE REGIONAL SURVEY
OF
DREDGING ACTIVITIES

1. This survey of dredging activities in the Asian and Pacific region has been made on the basis of replies to questionnaires issued by the ESCAP secretariat to the members and associate members of the Commission. These questionnaires were:

(a) ESCAP review of development in shipping, ports and inland waterways, 1984, questionnaire issued on 30 March 1984 (1);[a/]

(b) ESCAP inquiry - Dredging, questionnaire issued on 3 May 1984 (2).

Replies received until the end of September 1984 have been included.

2. Additional information on dredging activities in the member countries has been obtained from the following sources:

(a) World Dredging and Marine Construction (Irvine, California), March 1984 containing a directory of worldwide dredging fleets (3);

(b) Country papers presented at the Seminar on the Management of the Dredging Industry held at Shanghai, China, December 1983 (4);

(c) Mission reports of ESCAP's Regional Adviser on Dredging (Indonesia, Malaysia, Maldives and Thailand) (5);

(d) Dredging + Port Construction (Redhill, Surrey, United Kingdom), volume IX, No. 5, May 1982 and volume X, No. 3, March 1983 - "Asian survey" (6);

(e) Maritime Asia (Singapore), April 1983, June 1984 (7);

(f) Report of the feasibility study mission to Viet Nam - January 1979 (8).

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a/ Figures in parentheses indicate sources of information cited in tables 1 to 4.

DREDGER FLEETS

3. Dredgers have been classified by type and size as shown below. In those cases, where the furnished information does not allow for an unambiguous classification, the dredger size has been estimated.

Dredger fleet		SIZE			
		Small	Medium	Large	Very large
CS/S:	Diameter (inch)	< 10	10-20	20-30	> 30
	Horsepower	< 400	400-2000	2000-10000	> 10000
TH/SH:	Hopper volume (m^3)	< 200	200-1000	1000-5000	> 5000
	Horsepower	< 400	400-2000	2000-10000	> 10000
GH/BG/BL and others:	Grab volume (m^3)	< 2	2-10	> 10	-
	Horsepower	< 200	200-1000	1000-5000	

Notes:

CS/S - Cutter suction/suction
TH/SH - Trailing suction hopper/suction hopper
BD - Bucket dredger
GH/BG - Grab hopper/bucket grab

4. None of the sources used gives a complete, up-dated picture of the existing dredger fleets in the countries. Generally, where more than one source has been available, the sources have been complementary to each other. Thus table 1 does not pretend to provide complete information on dredger fleets in the member countries and areas.

Table 1. Dredger fleets

Country or area	Type of dredger[a/]	Number				Size not specified	Source of information[b/]
		Small	Medium	Large	Very large		
Australia	CS/S	15	16	3	1	3	(1), (3)
	TH/SH	-	2	2	1	1	
	GH/BG	3	4	2	-	1	
	Others	-	3	-	-	4	
Bangladesh	CS/S	-	1	-	-	1	(3)
	TH/SH	-	-	1	-	-	
	BH/BG	-	-	1	-	-	
Burma	TH/SH	-	1	-	-	-	(1), (3),
	BH/BG	3	1	-	-	1	(4)
China:							
Other than	CS/S	-	3	15	-	-	(2), (3),
Taiwan	TH/SH	-	6	39	2	-	(4)
province	GH/BG	4	20	8	-	-	
Taiwan	CS/S	-	3	5	1	-	(3)
province	TH/SH	-	-	1	-	-	
Fiji[b/]		-	-	-	-	-	
Hong Kong	CS/S	-	2	2	-	-	(1), (3)
	GH/BG	-	13	1	-	-	
	Others	-	-	-	-	1	
India	CS/S	1	5	3	-	-	(1), (3),
	TH/SH	1	6	14	-	3	(4)
	GH/BG	1	2	2	-	4	
Indonesia	CS/S	3	22	6	-	-	(2), (3),
	TH/SH	-	4	10	-	-	(5)
	BG/BG	-	4	-	-	-	
	Others	-	4	1	-	-	
Japan	CS/S	3	20	64	13	-	(3)
	TH/SH	-	1	4	-	-	
	BD	-	6	-	-	-	
	GH/BG	4	14	7	-	-	
	Others	-	3	-	-	-	
Malaysia	CS/S	-	7	-	-	-	(2), (3),
	TH/SH	3	3	-	-	-	(4), (5)
	GH/BG	-	3	-	-	-	
	Others	-	-	2	-	-	
Maldives	CS/S	1	3	-	-	-	(5)

Table 1 (continued)

Country or area	Type of dredger[a/]	Number				Size not specified	Source of information[b/]
		Small	Medium	Large	Very large		
New Zealand	CS/S	1	6	1	-	-	(3)
	TH/SH	-	3	1	-	-	
	GH/BG	3	3	-		-	
	Others	-	3	-		-	
Pakistan	CS/S	-	1	-	-	-	(3)
	TH/SH	-	1	-	-	-	
	GH/BG	-	-	1		-	
	Others	-	-	2		-	
Philippines	CS/S	3	8	4	1	-	(2), (3),
	TH/SH	-	2	3	-	-	(4)
	BD	-	1	-		-	
	GH/BG	-	2	-		-	
	Others	-	5	-		1	
Republic of Korea	CS/S	-	2	9	1	14	(2), (3),
	TH/SH	-	-	-	-	2	(4)
	GH/BG	9	7	1	-	5	
Singapore	CS/S	1	2	5	3	-	(3), (4)
	TH/SH	-	-	1	-	-	
	GH/BG	-	15	-		1	
	Others	-	-	-		2	
Sri Lanka	CS/S	-	1	-	-	-	(3), (4)
	TH/SH	-	1	-	-	-	
	GH/BG	-	3	-		-	
Thailand	CS/S	6	46	1	-	-	(2), (3),
	TH/SH	1	4	2	-	-	(4), (5)
	BD	-	4	-		-	
	GH/BG	8	8	-		-	
	Others	3	1	-		-	
Viet Nam	CS/S					11	(8)
	TH/SH	-	1	1	-	-	(3)

a/ See paragraph 3 for classification of dredger.

b/ See paragraphs 1 and 2 for sources of information.

c/ The Port Authority of Fiji intends to procure a dredger. At present, dredger are hired on an *ad hoc* basis.

Table 2. Capital dredging requirements

Country	Government agency/port authority/port	Capital dredging (thousand m^3)										Source of information[a/]
		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	
Australia[b/]	Port of Brisbane Authority	1 000	2 800	140	700	100	-					(1)
	Fremantle Port Authority	Minimal										(4)
	Port of Melbourne Authority	920	900	772	585	312	450					(1)
Bangladesh	Chittagong	-	-	-	-	-	-		3 500[c/]			(6)
Burma[d/]	Burma Ports Corporation (Rangoon)	-	-	-	-	-	-					(1) (4) (6)
China[b/]	Waterway Bureau:											
	Changjiang	6 220	5 000	2 850	2 228	810	3 000	4 000	5 000	6 000	7 000	
	Guangzhou	4 600	5 190	2 820	4 000	4 760	2 220	5 000	7 000	9 000	11 000	
	Shanghai	8 400	14 950	4 550	5 000	5 130	7 430	8 000	9 000	10 000	11 000	(2)
	Tianjin	9 680	7 400	9 450	11 610	12 710	11 240	13 000	14 000	15 000	16 000	(4)
India[e/]	Port Trust, Bombay[f/]	-	-	-	-	-	-	-	-	-	-	(1) (6)
Indonesia	Directorate General for Sea Transport, Ministry of Communication	7 000	9 840	7 500	40 000	11 000	1 000	8 000	16 000	11 000	11 000	(1) (2) (5)
Japan	Nagoya	672	1 428	1 145	278	956	375					(1)
	Tokyo	120	120	230	100	110	100					
	Yokohama	-	-	-	41	-	-					
Malaysia	Bintulu Port Authority	...	...	...	...	277	1 400					(1) (2)
	Kelang Port Authority	-	-	450	-	2 700	500					
	Penang Port Authority	570	-	-	8 205	4 102	-	-	650			
	Port Kelang Power Station			2 000								(6)
	Tanjeng Berhala			3 000								
	Georgetown Harbour, Penang				15 000							
Maldives	Land reclamation, Hulule Airport (1977/78 = 1 250)											(5)
	Male, land reclamation	26	126	130	110	...	...	...				
	Thuloesdoo and other islands[g/]											
New Zealand	Auckland	-	-	-	30	88	59					(1)

Table 2. (continued)

Country	Government agency/port authority/port	Capital dredging (thousand m^3)										Source of information a/
		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	
Pakistan	Karachi	5 080	3 740	3 340	86	77	94					(1)
Papua New Guinea	Lae Port h/											(6)
Philippines	Philippine Ports Authority	1 074	-	-	i/	i/	i/	-	-	-	-	(1) (2) (4)
Republic of Korea	Dredging works carried out by three of the major dredging companies for Korea Maritime and Port Administration	...	...	...	7 349	6 958	7 344	7 800				(2) (6)
Singapore	Port of Singapore Authority	27	1 686	55	180	180	5					(1) (4) (6)
Sri Lanka	Colombo Port j/											
	Galle Harbour					---- 700 ----						
Thailand	Harbour Department k/	927										

Notes: a/ See paragraphs 1 and 2.

b/ Data for 1979 to 1983 are for financial years.

c/ Capital and maintenance dredging.

d/ Dredging being planned at Akyab, Bassein, Kyankpyu and Moulmein.

e/ Capital dredged planned or being carried out at Mormugao and Tuticorin.

f/ Construction of a port in Nhava Sheva, near Bombay, in the near future will involve capital dredging of 8 million m^3.

g/ Capital dredging at some islands is being planned for navigational purposes.

h/ Dredging of 2 million m^3 of silt has been projected.

i/ Annual average, 1982-1984, 950,000 m^3.

j/ Development dredging of 1 million m^3 planned.

k/ Dredging activities planned for Bandon and Pattani.

Table 3. Maintenance dredging requirements

Country or area	Government agency/port authority/port	Maintenance dredging (thousand m^3)											Source of information[a/]
		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
Australia[b/]	Port of Bristane Authority	1 800	1 800	2 860	1 500	3 200							(1)
	Fremantle Port Authority	----------					Minimal						(1)
	Port of Melbourne Authority	671	602	804	664	475	50						(1)
Bangladesh	Chittagong	-	-	-	-	-	-		3 500[c/]				(6)
Burma[d/]	Burma Ports Corporation (Rangoon)	281	779	851	903	781	-	-	-	-	-	-	(1) (5) (6)
China[b/]	Waterway Bureau:												(2)
	Changjiang	7 580	7 700	7 600	8 520	7 560	8 000	9 000	10 000	11 000	12 000		
	Guangzhou	10 880	5 820	5 270	...	3 870	5 840	6 000	6 000	7 000	8 000		
	Shanghai	21 200	33 090	29 370	...	32 550	28 050	30 000	32 000	34 000	36 000		
	Tianjin	13 170	7 700	6 880	6 360	8 920	9 310	10 000	11 000	12 000	13 000		
Fiji[e/]	Ports Authority of Fiji												(1)
Hong Kong[b/]	Government Secretariat Port of Victoria	267	251	196	274	394							(1)
India[b/]	Dredging Corporation of India												
	East Coast ports less Calcutta/Haldia	----------					Annually: approximately 5 000						(4)
	Calcutta/Haldia	----------					Annually: approximately 15 000						
	West Coast Ports	----------					Annually: approximately 17 000						
	Calcutta Port Trust	5 250	5 435	9 792	15 307	13 509	13 968						(1)
	Port Trust Bombay		4 542	4 542	4 542	4 542	4 443						(1)
			2 207	3 767	2 256	2 545	2 753						
Indonesia[d/]	Directorate-General for Sea Transport, Ministry of Commerce		15 040	17 203	21 741	23 200	26 890	26 480	25 150	29 380	27 550	29 380	(1) (2) (5)
Japan[b/]	Nagoya	208	299	13	-	-	24						(1)
	Tokyo	400	400	400	400	400	400						
	Yokohama		190	202	137	128							
Malaysia	Bintulu Port Authority	...	...	...	...	-	1 700	...	...	...	...		(1) (2)
	Kelang Port Authority	150	190	195	165	291	350	350	350	350	350		
	Penang Port Authority	438	728	612	606	606	613	575	2 400	1 200	1 200		

Table 3. (continued)

Country or area	Government agency/port authority/port	Maintenance dredging (thousand m^3)											Source of information a/
		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	
Malaysia (continued)	Peninsular Malaysia (excluding five major ports):												(4)
	East Coast		----------	Annually:	3 700	----------							
	West Coast		----------	Annually:	3 600	----------							
	Five major ports (Bintulu, Kelang, Kemaman, Kuantan, Penang)		----------	Annually:	4 000	----------							
New Zealand	Auckland	149	67	15	14	21	18						(1)
	Wellington						25						
Pakistan	Karachi	12 830	14 050	13 600	11 870	12 560	8 470						(1)
Philippines	Philippine Ports Authority	7 597	8 571	12 720	813	2 789	5 820	5 940	5 940	6 050	6 050	6 380	(1) (2) (4)
Republic of Korea b/	Dredging works carried out by three of the major dredging companies for Korea Maritime and Port Administration	241	311	177	472	170	630						
Singapore	Port of Singapore Authority	276	279	270	271	286	458						(1) (6)
Thailand	Harbour Department	2 368	408	2 315	2 172	2 436							(1) (2) (4)
	Royal Irrigation Department (Inland Waterways)	12 450	10 386	12 213	9 762	13 642							(5) (6)

Notes: a/ See paragraphs 1 and 2.

b/ Data for 1979 to 1984 are for financial years.

c/ Capital and maintenance dredging.

d/ Dredging planned at Akyab, Bassein, Kyankpyu and Moulmein.

e/ Dredges occasionally hired on an ad hoc basis.

f/ Achieved output. Some docks and basins silting up.

g/ Data for 1979 to 1989 are for financial years.

Table 4. Manpower resources

Country	Government agency/ port authority/ port	Total	Officers	Non-technical, administrative and financial staff	Supervisors and overseers	Operational crew	Mechanical crew	Training facilities	Source of information[a]
Australia	Port of Melbourne Authority	139	----------	44	----------	95 (17[b]/[c]/[d]/78[e])	----------	Information not available	(1)
	Port of Brisbane Authority	119	----------	38	----------	81 (39[b]/[c]/[d]/42[e])	----------		
Burma	Burma Ports Corporation	105	----------	4	----------	101 (36[b]/[c]/[d]/65[e])	----------	Information not available	(1)(4)
China	Changjang Waterway Bureau, Dredging Department	2 360	234 (65[b]/ 169[c]/)	460 (236[b]/171[c]/53[d]/)	156 (50[b]/106[c]/)	758 (156[b]/539[c]/63[d]/)	752 (148[b]/546[c]/58[d]/)	Wuhan Water Transport Engineering Institute	
	Guangzhou Waterways Bureau Dredging Department	2 539	265 (90[b]/ 175[c]/)	450 (287[b]/113[c]/50[d]/)	100 (80[b]/ 20[c]/)	862 (220[b]/577[c]/65[d]/)	862 (230[b]/568[c]/64[d]/)	Jimei Marine Transport Special School (in Xiamen, Fujian Province)	(2)
	Shanghai Waterways Bureau, Dredging Department	6 751	305 (150[b]/155[c]/)	900 (800[b]/100[c]/)	200 (180[b]/20[c]/)	2 698 (650[b]/1 898[c]/150[d]/)	2 648 (600[b]/1 908[c]/140[d]/	Dalian Marine Transport Institute Tianjin University	
	Tianjin Waterways Bureau, Dredging Department	3 189	285 (100[b]/185[c]/)	492 (450[b]/42[c]/)	141 (120[b]/21[c]/)	1 171 (300[b]/800[c]/71[d]/)	1 100 (285[b]/750[c]/65[d]/)	East China Technical University of Water Resources (in Nanjing)	
India	Bombay Port Trust	771	----------	23	----------	748 (200[b]/[c]/[d]/ 548[e]/)	----------	Information not available	(1)
	Dredging Corporation of India, Ltd.	...						All-India Dredging cadre plans to establish own dredging school	(4)
Indonesia	Directorate-General for Sea Transport, Ministry of Commerce	2 236	----------	841	----------	775	620		(2)
	Surabaya	201	----------	28	----------	173 (20[b]/[c]/[d]/ 153[e]/)	----------	Information not available	(1)

Table 4. (continued)

Country	Government agency/port authority/port	Total	Officers	Non-technical, administrative and financial staff	Supervisors and overseers	Operational crew	Mechanical crew	Training facilities	Source of information [a]
Malaysia	Port Kelang Authority	30	1	-	1[c]	28[c]	-	Information not available	(1) (2)
	Port Penang Authority	108	1[c]	1	1[c]	64[c]	41[c]		
	Marine Department	...			...			No training facility -acute shortage of trained people at all levels	(4) (5)
Maldives	Department for Public Works and Labour	...			...			No training facility -acute shortage of trained people at all levels	(5)
New Zealand	Auckland	11		4		7 (1[b/c/d] 6[e])			
	Wellington	17			...			Information not available	(1)
Pakistan	Karachi	3 913		58		3 855 (3 406[b/c/d] 499[e])		Information not available	(1)
Philippines	Philippines Ports Authority	167	17[c]	13	16[b]	89[b]	32[b]	Training programme conducted abroad - expartriate experts on board some of vessels	(2) (4)
Republic of Korea	Two of the major dredging companies	103		26		39 (21[b] 18[c])	38 (20[b] 18[c])		
		52	2[b]	2	2[b]	8 (3[b] 5[c])	38 (8[b] 25[c] 5[d])	Information not available	(2)
Singapore	Port of Singapore Authority	70		2		68 (10[b/c/d] 58[e])		Information not available	(1) (4)
Thailand	Port Authority of Thailand, Bangkok	354		62		180	112		(2)
	Harbour Department	approx. 1 100	114	26	413	Crewsmen employed on temporary basis: 550 [e]		Acute shortage of trained people at all levels - training facilities not available in the country	(2) (4)

Notes: a/ See paragraphs 1 and 2.
b/ Number formally trained in dredging (trained in an institution within country or abroad for a period of at least three months).
c/ Number trained on the job (trained on the job under trained trainers for a period of at least three months).
d/ Number casually trained (trained while working).
e/ Unskilled or untrained.